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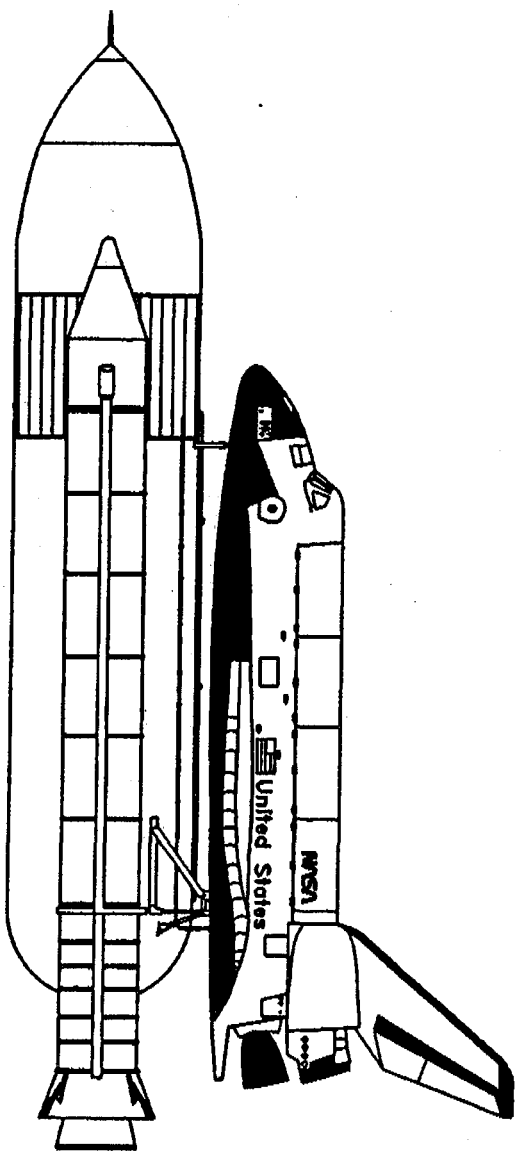

Test Report

Validation of NHB 8060.1C, Test 18 Arc Tracking

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Test Report

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Abstract

A test project was conducted to validate Test 18 of NHB 8060.1C and, if necessary, identify and recommend improvements in the procedures or criteria of the test. The NHB 8060.1C, Test 18 test system was modified to produce better discrimination of test results. Changes, and their effects on test results, in the graphite immersion-depth, test timing sequence, and atmospheric conditions were investigated for the wire-insulation constructions tested. Based on the test results, the graphite immersion-depths (between 0.8 mm and 1.6 mm), the timing sequence, and the change in the test conditions from ambient to three environments common in manned spaceflight did not significantly affect test results. The criteria used in Test 18 of NHB 8060.1C was found to be appropriate for qualifying arc-tracking and arc-propagation characteristics of wire-insulation materials. Using the Test 18 criteria, Kapton and ETFE were considered inappropriate for use, while PTFE was considered appropriate. Recommendations from this test project for Test 18 of NHB 8060.1C include changing the experimental setup and configurational tests and performing qualification testing in air rather than in the three environments common in manned spaceflight.

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Contents

1.0 Introduction

Test 18 of NASA Handbook NHB 8060.1C (NASA 1990) was developed to identify wire-insulation constructions that arc track. The NASA White Sands Test Facility (WSTF) was asked to evaluate the validity of this test for various wire-insulation constructions proposed for use in spacecraft. This test report describes the objectives, background, experimental approach, test articles, test system, test procedures, results and discussion, and recommendations for the arc-tracking project.

2.0 Objectives

The objectives of the test were to (a) validate Test 18 of NHB 8060.1C., and (b) if necessary, identify problems and recommend improvements in the procedures or criteria of the test.

3.0 Background

Arc tracking is a phenomenon that can occur as the result of an electrical current drawn between two conductors initially separated by certain insulation materials. During the arc-tracking process, the insulation is affected in such a manner as to form a low-resistance path or track between the conductors. Thus, when the current is extinguished by removing power from the conductors, and then the power is reapplied, the current again flows across the conductors and "restrikes." The resulting restrike can occur at current levels below that required for circuit-protecting devices, such as fuses and circuit breakers, to operate. This phenomenon can continue unabated and create a fire hazard or other undesirable conditions.

The only standard test available to evaluate this phenomenon under dry conditions (as on spacecraft) is ASTM-D-495 (ASTM 1986), which evaluates the formation of conductive paths on electrical insulations when exposed to high-voltage, low-current arcs under laboratory conditions. This test, however, is only useful to compare results between lots of the same insulation under laboratory conditions. Current standard tests do not predict the propensity of various wire-insulation constructions to arc track in actual-use situations. Consequently, the ASTM D9 committee has commissioned the ASTM-D 09.16 Task Force to develop a new, dry arc-tracking test method. One of the dry arc-tracking tests being considered by the ASTM D9 committee has been adapted by NASA as NHB 8060.1C, Test 18.

The criteria to determine the arc-tracking resistance of wire configurations in Test 18 of NHB 8060.1C requires the testing of at least three seven-wire bundles of the wire-insulation material. Arc propagation on either initial application of power or on reapplication of power is considered a test failure. It is required that these tests be conducted on samples of worst-case use insulation thickness and wire gauge, and in the worst-case environment.

4.0 Experimental Approach

Validating Test 18 of NHB 8060.1C was based on confirming the (1) repeatability of the restrike test results, (2) consistency of these results with the known performances of fluorocarbon/polyimide (Kapton) and polytetrafluoroethylene (PTFE) wire-insulation

materials, and (3) ability to obtain repeatable results from currently used advanced aircraft wire of complex composition [crosslinked, modified ethylene tetrafluorethylene (ETFE)] with unknown performance characteristics.

The test project had two test phases. Phase I was conducted under WSTF ambient conditions and assessed the repeatability of the arc-tracking and arc-restrike test results from Test 18 of NHB 8060.1C when critical test parameters, such as graphite immersion-depth and test timing sequences, were varied. Spherical copper powder (100 mesh) was used to compare the results of a lubricant (graphite) and a conductive powder to initiate and restrike the arc. The graphite immersion-depth and timing sequence that gave the most repeatable arc-track initiation and arc-track restrike test results for Phase I were used for Phase II. Phase II was conducted in a flammability test chamber at three specific atmospheric conditions used for the manned areas of the Space Shuttle and assessed both repeatability of the arc-restrike test results and the consistency of those results with the known performance characteristics of Kapton and PTFE wire-insulation materials.

In order to determine if the arc-tracking test would be repeatable and consistent for a material of unknown arc-tracking and arc-restriking characteristics, ETFE was tested. Current research indicates Kapton will arc track and PTFE will not.* Similar data on ETFE does not exist; however, test conditions and procedures must be capable of producing repeatable results for this wire-insulation material if Test 18 is to be valid for any aerospace wire-insulation material. Obtaining consistent results from the ETFE was important in validating Test 18 for future complex-insulation formulations that may have undocumented composition variability within batches.

During Phase I and Phase II, oscilloscope traces of the voltage and current applied to the wire-insulation materials were recorded to ensure that the power applied to the test bundles was consistent for all tests.

5.0 Test Articles

Testing included two aerospace wire-insulation materials with predictable arc-tracking characteristics and composition: MIL-W-81381/8-20 (Kapton) and MIL-W-16878/4-20 (PTFE). In addition, a current-use aerospace wire-insulation material, MIL-W-22759/32-20 (ETFE), with unknown arc-tracking characteristics and composition, was studied. All wires were 20 AWG, which is the most common wire gauge for power distribution systems aboard both the Space Shuttle and Space Station Freedom. Detailed procurement information for the wire-insulation materials is given in Appendix A.

Each wire-insulation material was fabricated into a 45.7-cm-long, seven-wire bundle. All bundles were prepared according to the procedures in Test 18 of NHB 8060.1C. Figure 1 is a pretest photograph of the three typical test bundles.

*NASA-KSC Malfunction Lab, *Cable Failure Investigation in the Space Lab D1 Module*, S/N 13, 4/7/88.

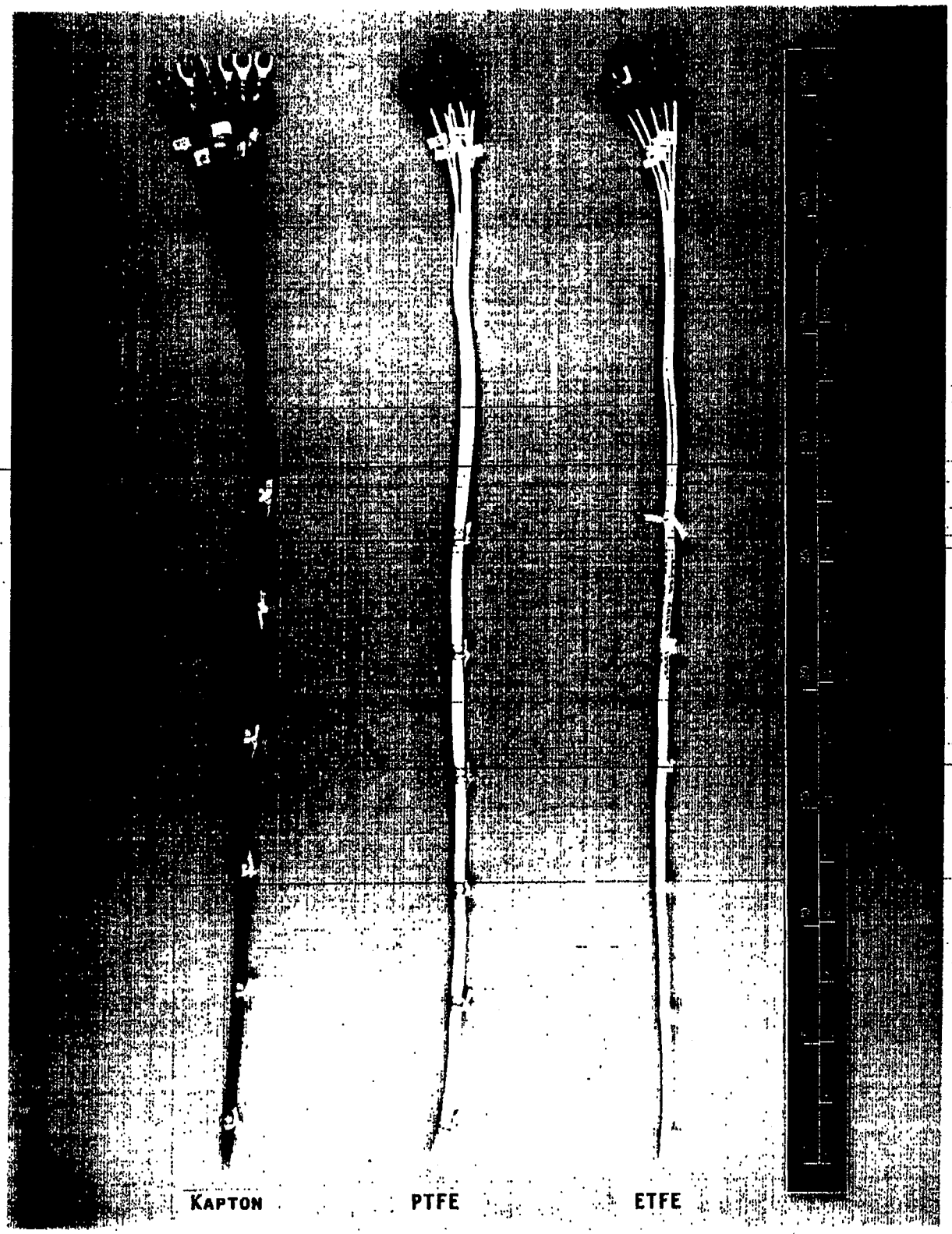

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Figure 1
Pretest Photograph of Three Typical Test Bundles

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6.0 Test System

The peak current provided to the test bundles by the current Test 18 test system over-drives the arc-track and arc-restrike phenomenon and does not allow good discrimination of the results for different materials; therefore, the test system was modified to limit the peak current applied to the test bundles. The functional schematic for the modified test system is depicted in Figure 2. This modified test system takes the 7.5 kW available from the power supply and uses resistors to provide approximately 16 amps to the test bundle. This system works well to delineate between the test sample materials and is adequate for screening candidate materials.

NHB 8060.1C, Test 18 requires reporting of the peak current for each test. The peak current is a generic observation that is the same for all tests and is system dependent, not test sample dependent. The only use for this test system parameter is to verify that the test bundle is subjected to enough power to promote arc tracking and arc restriking.

7.0 Phase I

7.1 General Procedures

Phase I testing was conducted in a fume hood at WSTF ambient conditions, approximately 85 kPa and 20.9-percent oxygen. For adequate ventilation, the fume hood door was adjusted to maintain a minimum air velocity of approximately 0.51 m/s. The arc tracking and arc restrike of each wire-insulation material was tested by dipping one end of each test bundle into a specified lubricant (graphite) or conductor [spherical copper powder (100 mesh)] at a certain immersion-depth. Power was then applied to each test bundle for 1 second (Time 1). This initial power application was used to produce an arc. If an arc was not produced, then the test was discontinued. If, however, an arc was produced, then the power was shut off for 5 seconds (null period) and then reapplied to the test bundle for an additional 30 seconds (Time 2).

Oscilloscope traces of the voltage and current for the test bundles (Figure 2b) were obtained for each of the three electrical phases (A, B, C) for Time 1 and Time 2. These traces were recorded for each test bundle for different graphite immersion-depths and timing sequences.

Data were recorded for all tests. All tests were videotaped and test bundles were photographed. The test bundles were cataloged and archived.

7.2 Graphite Immersion-depth

7.2.1 Procedures

Graphite immersion-depth testing was performed to determine if variations in depth of graphite, within limits specified in NHB 8060.1C, Test 18, affect the arc-tracking and arc-restrike test results. Each test bundle was tested at graphite immersion-depths of 0.8 mm, 1.2 mm, and 1.6 mm. A minimum of ten replicate tests were conducted for each variable to assess the repeatability of the arc-tracking and arc-restrike test results.

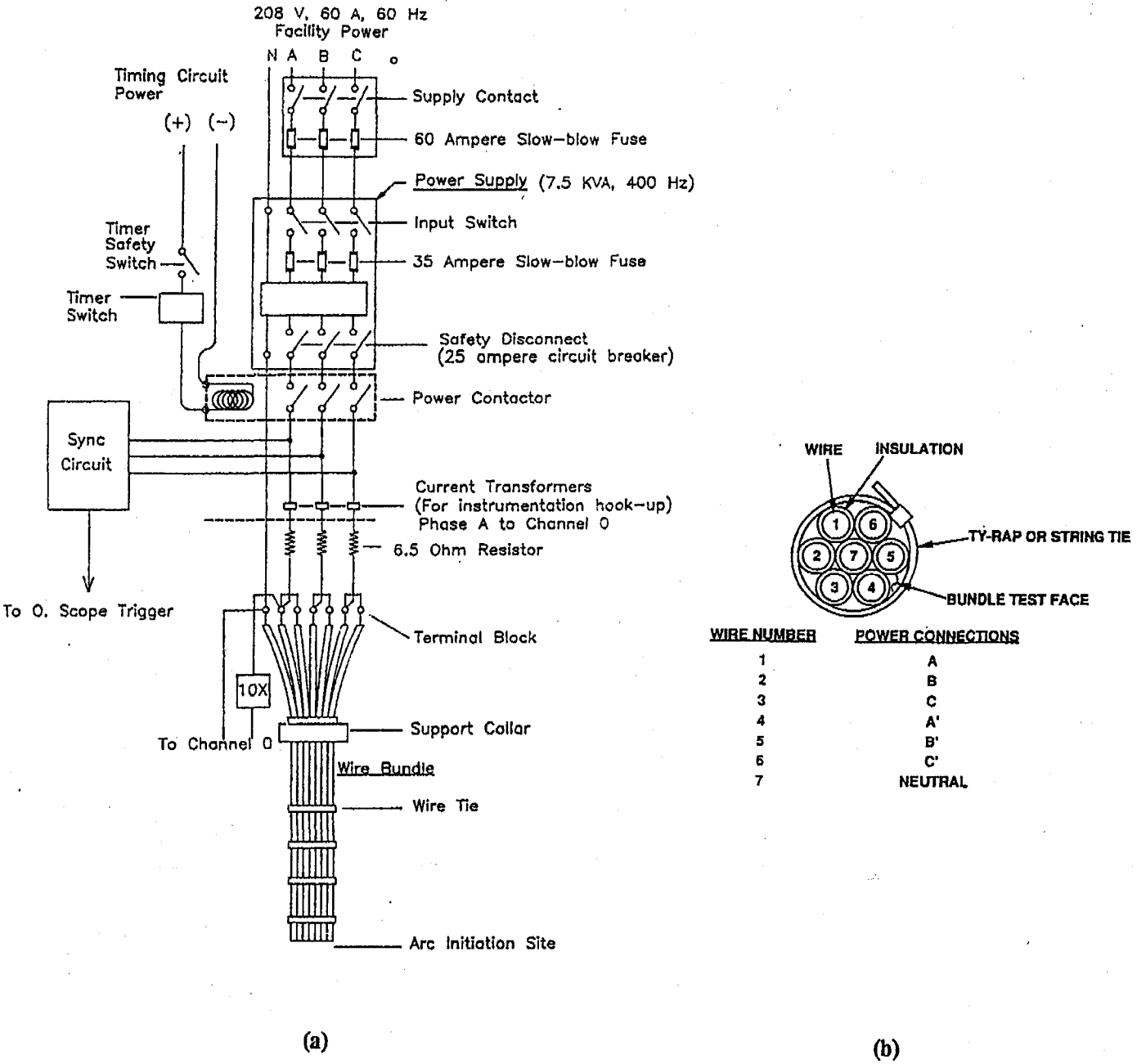

Figure 2
Test System Used to Validate Test 18 of NHB 8060.1C
(a) Functional Schematic (b) Wire Bundle

7.2.2 Results and Discussion

Figure 3 is a posttest photograph of the three typical test bundles. The graphite immersion-depth test results for Kapton, PTFE, and ETFE are in Appendix B. A summary of the results for Phase I are given in Table 1. The results show that Kapton restruck an arc and propagated the arc for all three depths of graphite. In most tests, the lubricated end of the test bundle massively arced* during Time 1. During Time 2, the lubricated end of the test bundle massively or mildly arced** and propagated the arc, accompanied with either a short duration flame or consuming flame. In all cases, regardless of the graphite immersion-depths, the Kapton test bundle was consumed. The depth of the graphite lubricant used in the Kapton tests, within the limits tested, appeared to have no effect upon the test results. The results given were repeatable and consistent with the arc-restrike and arc-propagation characteristics previously reported for Kapton.

PTFE neither propagated an arc nor was consumed for any of the three depths of graphite. Typically, the PTFE would quickly self-extinguish the arc during Time 1 followed by no action during Time 2. The results given were repeatable and consistent with the arc-restrike and arc-propagation characteristics previously reported for PTFE.

ETFE generally massively arced during Time 1. During Time 2, ETFE either short spit, mildly arced, or massively arced, accompanied with a short circuit. In all the ETFE tests, propagation distances were small (less than or equal to 13 mm). All of these results were repeatable and consistent (no anomalies appeared) with the arc-restrike and arc-propagation characteristics found throughout the ETFE testing.

Based on the graphite immersion-depth test results, the graphite immersion-depth, between the limits tested (0.8 mm and 1.6 mm), was not critical in producing both repeatable and consistent results for Kapton, PTFE, and ETFE. Because the repeatable and consistent test results were independent of a specific graphite immersion-depth, the middle graphite immersion-depth of 1.2 mm was used in all subsequent testing.

Since Kapton and ETFE produced an arc and propagated the arc, they do not meet the NHB 8060.1C, Test 18 criteria for acceptance as appropriate wire-insulation materials. Although in several single tests ETFE did not arc track or propagate the arc, this never occurred more than once in the ten test sets performed at each of the stated conditions. Because the NHB 8060.1C, Test 18 requires a minimum of three tests of each test bundle, ETFE did not pass the Test 18 criteria, as would be the case if only one test was required of each test bundle. PTFE did not produce an arc; therefore, according to the NHB 8060.1C, Test 18 criteria, PTFE is an acceptable wire-insulation material.

The oscilloscope traces for the three wire-insulation materials were the same for all three electrical phases; therefore, only one phase (phase A) was monitored for subsequent tests.

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*"Massively arced" is defined as the production of large amounts of luminous ejecta accompanied by a high luminosity at the arc-track location.

**"Mildly arced" is defined as the production of relatively small amounts of luminous ejecta, as compared to massively, and a lower total luminosity at the arc-track location.

Table 1
Summary of Phase I Graphite Immersion-depth Test Results

Wire-Insulation Materials	Number of Tests	Graphite Depth (mm)	Gas	Pressure (kPa)	Time Parameters (s)			Burn Length[a] (cm)	Sample Weight Loss[a] (g)
					Time 1	Null	Time 2		
Kapton	10	1.6	Air	85	1	5	30	4.5 ± 2.4	1.2 ± 1.0
Kapton	10	1.2	Air	85	1	5	30	8.2 ± 4.5	2.0 ± 1.1
Kapton	10	0.8	Air	85	1	5	30	6.9 ± 2.9	1.8 ± 0.9
PTFE	10	1.6	Air	85	1	5	30	0.0 ± 0.0	0.0 ± 0.0
PTFE	10	1.2	Air	85	1	5	30	0.0 ± 0.0	0.0 ± 0.0
PTFE	10	0.8	Air	85	1	5	30	0.0 ± 0.0	0.0 ± 0.0
ETFE	10	1.6	Air	85	1	5	30	0.5 ± 0.3	0.03 ± 0.05
ETFE	10	1.2	Air	85	1	5	30	0.6 ± 0.3	0.02 ± 0.04
ETFE	10	0.8	Air	85	1	5	30	0.4 ± 0.2	0.02 ± 0.04

[a]Data represent the average values ± one standard deviation

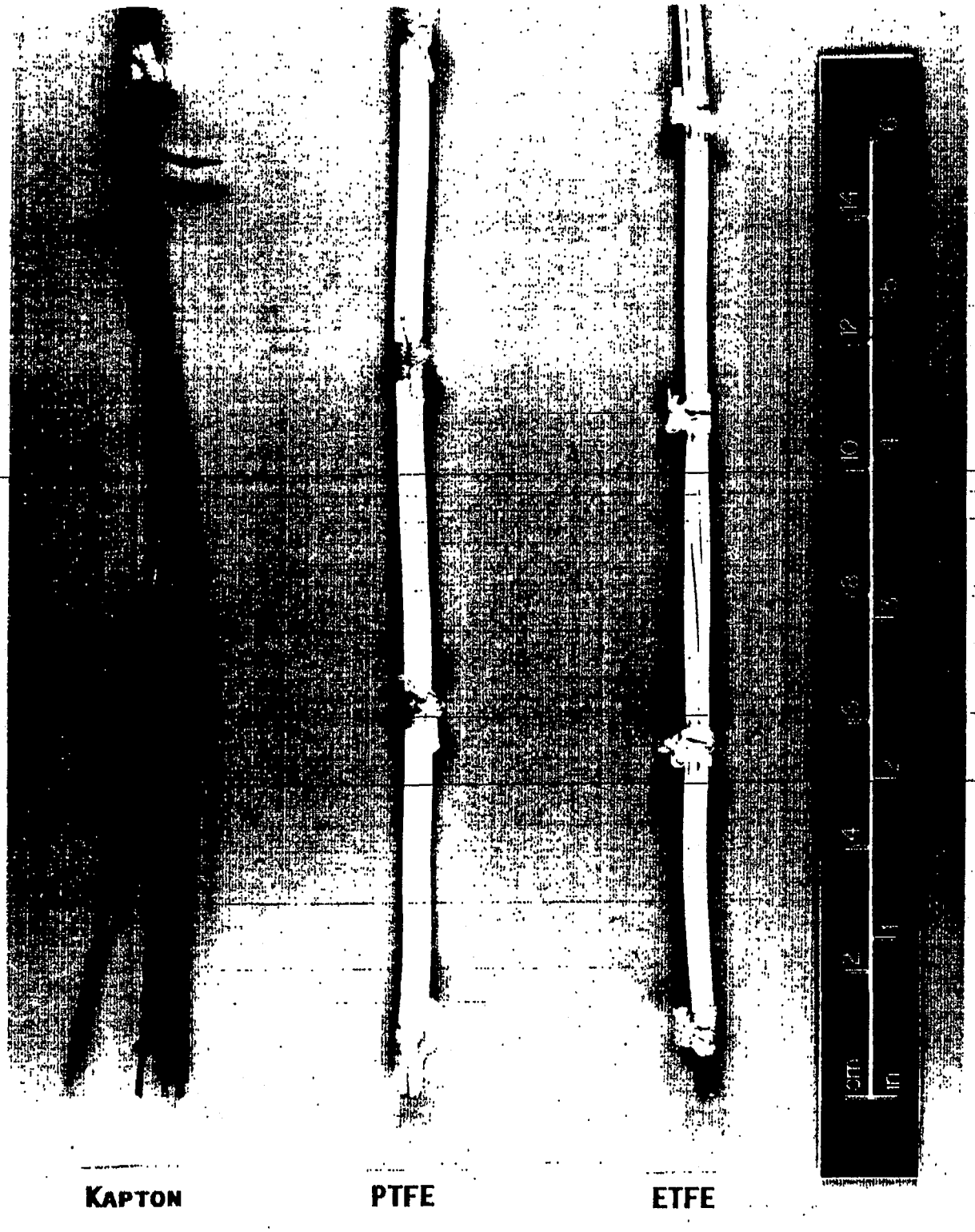

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Figure 3
Posttest Photograph of Three Typical Test Bundles

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7.3 Spherical Copper Powder Immersion-depth

7.3.1 Procedures

Five tests with each test bundle were performed using a spherical copper powder (100 mesh) conductor at a depth of 1.2 mm.

7.3.2 Results and Discussion

The results for the copper powder immersion-depth tests are in Appendix B. Kapton produced one short spit during Time 2, PTFE produced one short spit during Time 1, and ETFE produced two short spits during Time 1. No other activity was noticed for any of the three wire-insulation materials. Although the copper powder results were repeatable, they are inconsistent with the more extreme graphite lubricant results and the known arc-restrike and arc-propagation performance reported for Kapton. Because of the inconsistent copper powder results, the graphite lubricant (with a depth of 1.2 mm) was used for subsequent tests.

7.4 Time-Sequence Testing

7.4.1 Procedures

Time-sequence testing investigated the arc-tracking initiation and arc restrike of the bundles. Ten tests were performed at each of the time sets shown in Table 2 at the graphite immersion-depth of 1.2 mm.

7.4.2 Results and Discussion

The results of the time-sequence tests are in Appendix B and summarized in Table 3. The variation of length in Time 1 and in the null period did not change the test results. Regardless of the timing sequence, Kapton restruck an arc and propagated the arc a significant

Table 2
Timing Sequence For Phase I Testing on All Wire-Insulation Materials

Time 1 (Initial Power Application) (s)	Null Period (Power Off) (s)	Time 2 (Re-strike)[a] (s)
1	5	30
5[a]		30
1	10[a]	30
5[a]		30
1	20	30
5[a]		30

[a]Timing period specified by NHB 8060.1C, Test 18

Table 3
Summary of Phase I Time Sequence Test Results

Wire-Insulation Materials	Number of Tests	Graphite Depth (mm)	Gas	Pressure (kPa)	Time Parameters (s)			Burn Length[a] (cm)	Sample Weight Loss[a] (g)
					Time 1	Null	Time 2		
Kapton[b]	10	1.2	Air	85	1	5	30	8.2 ± 4.5	2.0 ± 1.1
Kapton	10	1.2	Air	85	1	10	30	6.3 ± 2.7	1.9 ± 1.1
Kapton	10	1.2	Air	85	1	20	30	9.3 ± 4.2	2.4 ± 1.2
Kapton	10	1.2	Air	85	5	5	30	4.9 ± 4.2	0.8 ± 0.8
Kapton	10	1.2	Air	85	5	10	30	6.1 ± 4.5	1.7 ± 1.8
Kapton	10	1.2	Air	85	5	20	30	5.9 ± 4.1	1.1 ± 1.0
PTFE[b]	10	1.2	Air	85	1	5	30	0.0 ± 0.0	0.0 ± 0.0
PTFE	10	1.2	Air	85	1	10	30	0.0 ± 0.0	0.0 ± 0.0
PTFE	10	1.2	Air	85	1	20	30	0.0 ± 0.0	0.0 ± 0.0
PTFE	10	1.2	Air	85	5	5	30	0.0 ± 0.0	0.0 ± 0.0
PTFE	10	1.2	Air	85	5	10	30	0.0 ± 0.0	0.0 ± 0.0
PTFE	10	1.2	Air	85	5	20	30	0.0 ± 0.0	0.0 ± 0.0
ETFE[b]	10	1.2	Air	85	1	5	30	0.6 ± 0.3	0.02 ± 0.04
ETFE	10	1.2	Air	85	1	10	30	0.6 ± 0.2	0.0 ± 0.0
ETFE	10	1.2	Air	85	1	20	30	0.5 ± 0.2	0.02 ± 0.04
ETFE	10	1.2	Air	85	5	5	30	0.8 ± 0.1	0.01 ± 0.03
ETFE	10	1.2	Air	85	5	10	30	0.8 ± 0.2	0.03 ± 0.05
ETFE	10	1.2	Air	85	5	20	30	0.6 ± 0.3	0.04 ± 0.10

[a]Data represent the average values ± one standard deviation
[b]Data was taken from the graphite immersion-depth tests

amount; PTFE did not arc track or propagate the arc; and ETFE restruck an arc and propagated the arc a small amount (less than 19 mm). The results for the Kapton and PTFE are repeatable and consistent with the known behavior of these materials, and are independent of the time parameters.

Based on the results, the times specified in the NHB 8060.1C, Test 18 are adequate for determining if a test sample would restrike an arc and propagate the arc, and were therefore used in all subsequent testing. The Kapton and ETFE failed to meet the criteria of NHB 8060.1C, Test 18 for acceptance as wire-insulation materials, while the PTFE does meet the NHB 8060.1C, Test 18 criteria.

8.0 Phase II

8.1 Procedures

Phase II testing was conducted using the procedures for Test 18 of NHB 8060.1C. Phase II was conducted in a 1.42-m^3 flammability test chamber under the three atmospheric conditions common to manned spacecraft (Table 4). For tests performed in Phase II, a graphite immersion-depth of 1.2 mm with the timing sequence of 5 seconds (Time 1), 10 seconds (null period), and 30 seconds (Time 2) was used. A total of ten tests were conducted for each matrix condition. The results of the Kapton and PTFE wire-insulation materials were compared with the known performance characteristics of these wires. Any conditions producing contrary results were identified.

8.2 Results and Discussion

The results for the three environmental condition tests are in Appendix B and summarized in Table 5. The test results indicate that during Time 1, Kapton massively arced, accompanied by propagation of the arc. During Time 2, the Kapton massively arced, accompanied by a consuming flame as the arc propagated. At all three atmospheric conditions the Kapton sample arced and propagated the arc. The PTFE produced only a short spit during Time 1

Table 4
Atmospheric Conditions For Phase II Testing on
All Wire-Insulation Materials

Total Pressure (kPa)	Percent Oxygen[a]
101	20.9
99	25.9
69	30.0

[a]Balanced against nitrogen

Table 5
Summary of Phase II Test Results

Wire-Insulation Materials	Number of Tests	Graphite Depth (mm)	Gas[a] (% O_2)	Pressure (kPa)	Time Parameters			Burn Length[b] (cm)	Sample Weight Loss[b] (g)
					Time 1	Null (s)	Time 2		
Kapton	10	1.2	30.1	69	5	10	30	11.2 ± 5.5	3.1 ± 1.6
Kapton	10	1.2	26.2	99	5	10	30	10.7 ± 5.2	2.8 ± 1.6
Kapton	10	1.2	20.9	101	5	10	30	9.1 ± 4.8	2.6 ± 1.6
PTFE	10	1.2	30.1	69	5	10	30	0.0 ± 0.0	0.0 ± 0.0
PTFE	10	1.2	26.2	99	5	10	30	0.0 ± 0.0	0.0 ± 0.0
PTFE	10	1.2	20.9	101	5	10	30	0.0 ± 0.0	0.0 ± 0.0
ETFE	10	1.2	30.1	69	5	10	30	0.6 ± 0.4	0.06 ± 0.05
ETFE	10	1.2	26.2	99	5	10	30	0.8 ± 0.5	0.06 ± 0.07
ETFE	10	1.2	20.9	101	5	10	30	0.8 ± 0.3	0.03 ± 0.05

[a]Balanced against nitrogen
[b]Data represent the average values ± one standard deviation

with no action during Time 2. At all three atmospheric conditions the PTFE sample neither propagated an arc nor was consumed. The ETFE massively arced during Time 1 and either short spit, mildly arced, or massively arced, accompanied with a short circuit, during Time 2. As in Phase I, the ETFE propagation distances were small (less than or equal to 15.2 mm). At all three atmospheric conditions, the ETFE sample arced and propagated the arc. The

Phase II test results for Kapton and PTFE were repeatable and consistent with the Phase I test results and with the known arc-restrike and arc-propagation characteristics previously reported for Kapton and PTFE. The ETFE test results were repeatable and consistent (no anomalies appeared) with the results from the other ETFE tests conducted within the scope of this program. The consistency of the ETFE test results show the validity of NHB 8060.1C, Test 18 for determining the fire hazard of complex insulation formations that may have undocumented composition variability within batches or unknown arc-restrike and arc-propagation characteristics.

As in Phase I, the results from Phase II show that Kapton and ETFE do not meet the NHB 8060.1C, Test 18 criteria for acceptance as appropriate wire-insulation materials. Similar to the Phase I results, there were single instances when the ETFE would not arc track or propagate the arc, but this would occur only once in a set of ten tests. Because the NHB 8060.1C, Test 18 requires a minimum of three tests of each test bundle, the ETFE did not meet the Test 18 criteria. If only one test was required of each test bundle, then the ETFE would have met the criteria. The PTFE does meet the NHB 8060.1C, Test 18 criteria for acceptance as an appropriate wire-insulation material.

9.0 Conclusions

Regardless of the changes in the test parameters (lubricant or conductor arc initiator, immersion-depth of the lubricant, duration of timing sequence, and environmental conditions), Test 18 of NHB 8060.1C is a valid test for screening candidate wire-insulation materials.

The arc initiator that gave the most consistent test results was graphite. The graphite immersion-depths of 0.8 mm, 1.2 mm, and 1.6 mm did not affect the arc-tracking or arc-restrike test results. Changing the timing sequence of Time 1 (1 and 5 seconds) and the null period (5, 10 and 20 seconds) did not affect the test results for Kapton, PTFE, or ETFE. Changing the environment from ambient to three environments common to manned spacecraft did not affect the test results of Kapton, PTFE, and ETFE. All test results were repeatable and consistent with the known and documented arc-tracking and arc-propagation characteristics of Kapton and PTFE. In addition, the test results were repeatable for ETFE, a material with undocumented arc-tracking and arc-propagation characteristics, and consistent with other ETFE test results within the scope of this test program.

Based on the results of this test project, the present criteria in NHB 8060.1C, Test 18, for determining the arc-tracking and arc-propagating resistance of wire-insulation materials, is appropriate and does not need modification.

10.0 Recommendations

The criteria and procedures of NHB 8060.1C, Test 18 should not be changed because the changes in test parameters (graphite immersion-depth, test timing sequence, and environmental conditions), within the scope of this test program, did not affect the test results. The experimental setup used in NHB 8060.1C, Test 18 should be modified to the setup described in this report in order to ensure good discrimination of the results for different materials.

NHB 8060.1C, Test 18 is a conservative screening test for materials to be used on manned vehicles and as such it may not adequately represent results to be expected from specific configurations. Therefore, materials that fail NHB 8060.1C, Test 18 and remain candidate materials should be tested in actual use configurations with realistic power sources. These configurational tests should be carried out with a DC power source that is presently used aboard the Space Shuttle and will be used aboard the Space Station Freedom.

In addition, the bulk of qualification testing of insulation materials should be conducted in ambient conditions since no differences in the arc-tracking and arc-propagation characteristics of the wire-insulation materials were found during tests conducted at ambient conditions and tests conducted at specified atmospheric conditions common to manned spacecraft.

References

NASA. *Flammability, Odor, Offgassing, and Compatibility Requirements and Test Procedures for Materials in Environments That Support Combustion.* NHB 8060.1C, NASA Office of Safety and Mission Quality, Washington, D.C., 1990.

ASTM. "Standard Test Method for High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation." *Annual Book of ASTM Standards, Vol. 08.01,* American Society for Testing and Materials, Philadelphia, 1986.

Appendix A
Procurement Information on Wire-Insulation Materials

ETFE - Ethylene tetrafluorethylene, 20 AWG electrical wire, MIL-W-22759/32-20. WSTF ID No. 90-24097. Manufacturer: Delta Suprenant Wire and Cable, Inc., 172 Sterling Street, Clinton, MA 01510. Vendor: Southwest Wire and Cable, Inc., 4320 F Yale Blvd., NE, Albuquerque, NM 87107.

Kapton - Fluorocarbon/polyimide, 20 AWG electrical wire, MIL-W-81381/8-20. WSTF ID No. 90-23836. Manufacturer: Teledyne Thermatics, P.O. Drawer 909, Elm City, NC 27822-0909. Vendor: Southwest Wire and Cable, Inc., 4320 F Yale Blvd., NE, Albuquerque, NM 87107.

PTFE - Polytetrafluorethylene, 20 AWG electrical wire, MIL-W-16878/4-20. WSTF ID No. 90-23843. Manufacturer: Teledyne Thermatics, P.O. Drawer 909, Elm City, NC 27822-0909. Vendor: Southwest Wire and Cable, Inc., 4320 F Yale Blvd., NE, Albuquerque, NM 87107.

Appendix B
Arc-Tracking Data

Appendix B Abbreviations

A	Massive arcing
M	Mild arcing
SF	Short duration Fire
CF	Consuming Fire
N	No action
SC	Short circuit
S	Short spit

Table B-1

Wire-Insulation Material: Kapton — WSTF ID #: 90-23836
Graphite Depth: 0.8 mm
Time 1: 1 s — Null: 5 s — Time 2: 30 s
Pressure: Ambient — Gas: Air

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	A, SF	A, CF	7.9	2.0
2	A, SF	M, SF	3.8	1.1
3	A	M, CF	8.4	3.2
4	A	M, CF	2.8	0.7
5	A	M, CF	5.8	2.3
6	A, SF	A, SF	7.4	1.0
7	A, SF	A, CF	12.2	1.6
8	A	M, CF	8.4	2.0
9	A	A, CF	8.9	3.3
10	A	M, SF	3.8	0.9

Table B-2

Wire-Insulation Material: Kapton — WSTF ID #: 90-23836
Graphite Depth: 1.2 mm
Time 1: 1 s — Null: 5 s — Time 2: 30 s
Pressure: Ambient — Gas: Air

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	A	M, CF	7.6	1.5
2	A, CF	M	0.8	0.1
3	A, SF	A, CF	12.7	2.3
4	A	A, CF	10.2	3.8
5	A	M, CF	7.1	2.0
6	A, SF	M, CF	3.3	0.3
7	A	M, CF	8.4	2.2
8	A	M, CF	5.8	2.2
9	A	M, CF	8.9	2.9
10	A	M, CF	16.8	2.9

Table B-3

Wire-Insulation Material: Kapton — WSTF ID #: 90-23836
Graphite Depth: 1.6 mm
Time 1: 1 s — Null: 5 s — Time 2: 30 s
Pressure: Ambient — Gas: Air

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	A	M, SF	3.6	0.1
2	M, SF	M, CF	5.8	2.9
3	A	M, CF	3.8	1.8
4	A	M, CF	7.6	2.0
5	A	M, CF	2.5	0.4
6	A, SF	S	1.3	0.1
7	A	M, CF	7.4	2.1
8	A	M, SF	2.8	0.5
9	A	M, CF	7.6	1.4
10	A	M, SF	2.8	0.3

Table B-4

Wire-Insulation Material: PTFE — WSTF ID #: 90-23843
Graphite Depth: 0.8 mm
Time 1: 1 s — Null: 5 s — Time 2: 30 s
Pressure: Ambient — Gas: Air

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	S	N	0.0	0.0
2	S	N	0.0	0.0
3	S	N	0.0	0.0
4	S	N	0.0	0.0
5	S	N	0.0	0.0
6	S	N	0.0	0.0
7	S	N	0.0	0.0
8	S	S	0.0	0.0
9	S	N	0.0	0.0
10	S	S	0.0	0.0

Table B-5

Wire-Insulation Material: PTFE — WSTF ID #: 90-23843
Graphite Depth: 1.2 mm
Time 1: 1 s — Null: 5 s — Time 2: 30 s
Pressure: Ambient — Gas: Air

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	S	N	0.0	0.0
2	S	N	0.0	0.0
3	M	M	0.0	0.0
4	S	N	0.0	0.0
5	S	M	0.0	0.0
6	M	N	0.0	0.0
7	S	N	0.0	0.0
8	S	N	0.0	0.0
9	S	N	0.0	0.0
10	S	N	0.0	0.0

Table B-6

Wire-Insulation Material: PTFE — WSTF ID #: 90-23843
Graphite Depth: 1.6 mm
Time 1: 1 s — Null: 5 s — Time 2: 30 s
Pressure: Ambient — Gas: Air

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	S	N	0.0	0.0
2	S	N	0.0	0.0
3	S	N	0.0	0.0
4	S	N	0.0	0.0
5	S	N	0.0	0.0
6	S	N	0.0	0.0
7	S	N	0.0	0.0
8	S	N	0.0	0.0
9	S	N	0.0	0.0
10	S	N	0.0	0.0

Table B-7

Wire-Insulation Material: ETFE — WSTF ID #: 90-24097
Graphite Depth: 0.8 mm
Time 1: 1 s — Null: 5 s — Time 2: 30 s
Pressure: Ambient — Gas: Air

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	A	M, SC	0.8	0.0
2	A	N, SC	0.3	0.0
3	A	S, SC	0.3	0.0
4	A, SC	N, SC	0.3	0.0
5	A	S, SC	0.3	0.0
6	A, SC	N, SC	0.3	0.0
7	A	M, SC	0.3	0.1
8	A, SC	N, SC	0.5	0.1
9	A	M, SC	0.8	0.0
10	M	S, SC	0.5	0.0

Table B-8

Wire-Insulation Material: ETFE — WSTF ID #: 90-24097
Graphite Depth: 1.2 mm
Time 1: 1 s — Null: 5 s — Time 2: 30 s
Pressure: Ambient — Gas: Air

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	A	S, SC	0.3	0.0
2	A	M, SC	1.0	0.0
3	A	M, SC	1.0	0.1
4	A	M, SC	0.8	0.0
5	A	M, SC	0.8	0.0
6	A	S, SC	0.3	0.0
7	A	S, SC	0.8	0.0
8	A	A, SC	0.8	0.1
9	A	S, SC	0.3	0.0
10	A	S, SC	0.3	0.0

Table B-9

Wire-Insulation Material: ETFE WSTF ID #: 90-24097
Graphite Depth: 1.6 mm
Time 1: 1 s Null: 5 s Time 2: 30 s
Pressure: Ambient Gas: Air

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	A	A, SC	1.0	0.1
2	A	A, SC	0.8	0.0
3	A	S, SC	0.3	0.1
4	A	S, SC	0.3	0.0
5	A	S, SC	0.3	0.0
6	A	S, SC	0.3	0.0
7	A	S, SC	0.3	0.0
8	A	S, SC	0.3	0.0
9	A	M, SC	0.8	0.1
10	A	S, SC	0.3	0.0

Table B-10

Wire-Insulation Material: Kapton WSTF ID #: 90-23836
Spherical Copper Powder 100 Mesh Depth: 1.2 mm
Time 1: 1 s Null: 5 s Time 2: 30 s
Pressure: Ambient Gas: Air

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	N	N	0.0	0.0
2	N	N	0.0	0.0
3	N	S	0.0	0.0
4	N	N	0.0	0.0

Table B-11

Wire-Insulation Material: PTFE WSTF ID #: 90-23843
Spherical Copper Powder 100 Mesh Depth: 1.2 mm
Time 1: 1 s Null: 5 s Time 2: 30 s
Pressure: Ambient Gas: Air

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	S	N	0.0	0.0
2	N	N	0.0	0.0
3	N	N	0.0	0.0
4	N	N	0.0	0.0

Table B-12

Wire-Insulation Material: ETFE WSTF ID #: 90-24097
Spherical Copper Powder 100 Mesh Depth: 1.2 mm
Time 1: 1 s Null: 5 s Time 2: 30 s
Pressure: Ambient Gas: Air

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	N	N	0.0	0.0
2	S	N	0.0	0.0
3	S	N	0.0	0.0
4	N	N	0.0	0.0

Table B-13

Wire-Insulation Material: Kapton — WSTF ID #: 90-23836
Graphite Depth: 1.2 mm
Time 1: 5 s — Null: 5 s — Time 2: 30 s
Pressure: Ambient — Gas: Air

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	A	A, CF	2.8	0.6
2	M	A, CF	1.3	0.2
3	M	A, CF	5.1	1.4
4	M	M, SF	7.1	1.5
5	A	A, SF	3.3	0.3
6	A	A, CF	14.7	1.8
7	M	A, CF	2.5	0.1
8	A	M, SF	8.4	2.0
9	M	A, CF	0.8	0.0
10	M	A, CF	2.5	0.1

Table B-14

Wire-Insulation Material: PTFE — WSTF ID #: 90-23843
Graphite Depth: 1.2 mm
Time 1: 5 s — Null: 5 s — Time 2: 30 s
Pressure: Ambient — Gas: Air

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	S	N	0.0	0.0
2	S	N	0.0	0.0
3	S	N	0.0	0.0
4	S	N	0.0	0.0
5	S	N	0.0	0.0
6	S	N	0.0	0.0
7	S	N	0.0	0.0
8	S	N	0.0	0.0
9	S	N	0.0	0.0
10	S	N	0.0	0.0

Table B-15

Wire-Insulation Material: ETFE WSTF ID #: 90-24097
Graphite Depth: 1.2 mm
Time 1: 5 s Null: 5 s Time 2: 30 s
Pressure: Ambient Gas: Air

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	A	S, SC	0.8	0.0
2	A, SC	S, SC	1.0	0.0
3	A, SC	SC	0.8	0.0
4	A, SC	S, SC	0.8	0.0
5	A	M, SC	0.8	0.0
6	A	M, SC	0.8	0.0
7	A, SC	SC	0.8	0.1
8	A	S	0.8	0.0
9	A	SC	0.8	0.0
10	A, SC	S, SC	1.0	0.0

Table B-16

Wire-Insulation Material: Kapton WSTF ID #: 90-23836
Graphite Depth: 1.2 mm
Time 1: 1 s Null: 10 s Time 2: 30 s
Pressure: Ambient Gas: Air

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	A	A, CF	10.4	3.8
2	A	M	2.0	0.5
3	A	A, SF	6.4	1.7
4	A	A, SF	7.6	2.2
5	A	M, SF	7.6	1.9
6	A	A, SF	7.6	2.3
7	A	M	3.8	0.7
8	A	M	2.5	0.6
9	A	M, SF	7.6	2.2
10	A	M, SF	7.6	3.2

Table B-17

Wire-Insulation Material: PTFE — WSTF ID #: 90-23843
Graphite Depth: 1.2 mm
Time 1: 1 s — Null: 10 s — Time 2: 30 s
Pressure: Ambient — Gas: Air

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	S	N	0.0	0.0
2	S	M	0.0	0.0
3	S	S	0.0	0.0
4	S	N	0.0	0.0
5	S	N	0.0	0.0
6	S	N	0.0	0.0
7	S	N	0.0	0.0
8	S	N	0.0	0.0
9	S	N	0.0	0.0
10	S	N	0.0	0.0

Table B-18

Wire-Insulation Material: ETFE — WSTF ID #: 90-24097
Graphite Depth: 1.2 mm
Time 1: 1 s — Null: 10 s — Time 2: 30 s
Pressure: Ambient — Gas: Air

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	A	A, SC	0.3	0.0
2	A	M, SC	0.5	0.0
3	M	A, SC	0.8	0.0
4	M	M, SC	0.8	0.0
5	M	M	0.8	0.0
6	S	A, SC	0.5	0.0
7	A	M	0.5	0.0
8	A	S, SC	0.5	0.0
9	A	S, SC	0.5	0.0
10	A	M, SC	0.8	0.0

Table B-19

Wire-Insulation Material: Kapton — WSTF ID #: 90-23836
Graphite Depth: 1.2 mm
Time 1: 5 s — Null: 10 s — Time 2: 30 s
Pressure: Ambient — Gas: Air

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	A	M	3.8	0.6
2	A	S	0.8	0.0
3	M	M	4.6	1.1
4	A	M, SF	8.4	1.7
5	A	M	2.5	0.1
6	A	M	2.5	0.4
7	A	A, CF	12.2	4.6
8	A	M	2.8	0.6
9	A	A, CF	12.2	3.9
10	A	A, CF	11.4	4.1

Table B-20

Wire-Insulation Material: PTFE — WSTF ID #: 90-23843
Graphite Depth: 1.2 mm
Time 1: 5 s — Null: 10 s — Time 2: 30 s
Pressure: Ambient — Gas: Air

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	S	N	0.0	0.0
2	S	N	0.0	0.0
3	S	N	0.0	0.0
4	S	M	0.0	0.0
5	S	N	0.0	0.0
6	S	N	0.0	0.0
7	S	N	0.0	0.0
8	S	N	0.0	0.0
9	S	N	0.0	0.0
10	S	S	0.0	0.0

Table B-21

Wire-Insulation Material: ETFE — WSTF ID #: 90-24097
Graphite Depth: 1.2 mm
Time 1: 5 s — Null: 10 s — Time 2: 30 s
Pressure: Ambient — Gas: Air

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	A	S, SC	0.8	0.0
2	A, SC	S, SC	0.8	0.0
3	A	S, SC	0.8	0.1
4	A, SC	S, SC	0.8	0.0
5	A	M, SC	1.2	0.1
6	A	N	0.8	0.0
7	A, SC	N, SC	0.8	0.1
8	A, SC	N, SC	0.5	0.0
9	A	M, SC	0.8	0.0
10	A, SC	N, SC	0.8	0.0

Table B-22

Wire-Insulation Material: Kapton — WSTF ID #: 90-23836
Graphite Depth: 1.2 mm
Time 1: 1 s — Null: 20 s — Time 2: 30 s
Pressure: Ambient — Gas: Air

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	S	M, SF	7.6	2.8
2	M	M, SF	6.3	2.0
3	A	A, CF	12.2	1.6
4	A	A, CF	17.3	3.8
5	M	N	2.0	0.1
6	A	A, CF	12.2	1.9
7	M	A, CF	10.2	3.9
8	A	M, SF	6.3	2.0
9	A	A, CF	10.2	2.9
10	A	A, SF	8.9	3.4

Table B-23

Wire-Insulation Material: PTFE — WSTF ID #: 90-23843
Graphite Depth: 1.2 mm
Time 1: 1 s — Null: 20 s — Time 2: 30 s
Pressure: Ambient — Gas: Air

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	S	S	0.0	0.0
2	S	M	0.0	0.0
3	S	N	0.0	0.0
4	S	N	0.0	0.0
5	S	N	0.0	0.0
6	S	N	0.0	0.0
7	S	N	0.0	0.0
8	S	N	0.0	0.0
9	S	N	0.0	0.0
10	S	N	0.0	0.0

Table B-24

Wire-Insulation Material: ETFE — WSTF ID #: 90-24097
Graphite Depth: 1.2 mm
Time 1: 1 s — Null: 20 s — Time 2: 30 s
Pressure: Ambient — Gas: Air

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	A	N, SC	0.5	0.0
2	A	M, SC	0.8	0.1
3	A, SC	N	0.5	0.0
4	A	S, SC	0.3	0.0
5	A	S, SC	0.5	0.0
6	A	M, SC	0.8	0.1
7	A	M, SC	0.5	0.0
8	A, SC	N	0.5	0.0
9	A	S, SC	0.3	0.0
10	M, SC	N	0.3	0.0

Table B-25

Wire-Insulation Material: Kapton — WSTF ID #: 90-23836
Graphite Depth: 1.2 mm
Time 1: 5 s — Null: 20 s — Time 2: 30 s
Pressure: Ambient — Gas: Air

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	A	M	3.3	0.5
2	A	A	2.5	0.4
3	A	A, CF	7.9	0.3
4	A	M	3.8	0.4
5	A	M	2.0	0.3
6	A	A, CF	12.7	2.1
7	A	A, CF	12.7	2.0
8	A	M	2.8	0.6
9	A	A, SF	3.8	3.0
10	A	A, SF	7.1	1.6

Table B-26

Wire-Insulation Material: PTFE — WSTF ID #: 90-23843
Graphite Depth: 1.2 mm
Time 1: 5 s — Null: 20 s — Time 2: 30 s
Pressure: Ambient — Gas: Air

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	S	N	0.0	0.0
2	S	N	0.0	0.0
3	S	N	0.0	0.0
4	S	M	0.0	0.0
5	S	N	0.0	0.0
6	S	N	0.0	0.0
7	S	N	0.0	0.0
8	S	N	0.0	0.0
9	S	M	0.0	0.0
10	S	N	0.0	0.0

Table B-27

Wire-Insulation Material: ETFE — WSTF ID #: 90-24097
Graphite Depth: 1.2 mm
Time 1: 5 s — Null: 20 s — Time 2: 30 s
Pressure: Ambient — Gas: Air

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	A	M, SC	0.8	0.0
2	A	M, SC	0.8	0.0
3	A	S, SC	0.5	0.0
4	A	S, SC	0.8	0.1
5	A	M	0.8	0.0
6	A	S	0.3	0.0
7	S, SC	N	0.0	0.0
8	A	S, SC	0.5	0.0
9	A, SC	N	0.8	0.3
10	A, S	S, SC	0.5	0.0

Table B-28

Wire-Insulation Material: Kapton — WSTF ID #: 90-23836
Graphite Depth: 1.2 mm
Time 1: 5 s — Null: 10 s — Time 2: 30 s
Pressure: 10.0 psia (69 kPa) — Gas: 30.1% O_2; 69.9% N_2

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	A, SF	A, CF	7.6	3.2
2	A, SF	A, CF	8.4	2.2
3	A, SF	A, CF	6.4	1.9
4	A, SF	N	3.8	0.6
5	A, CF	A, CF	21.3	4.7
6	A, SF	A, CF	8.9	2.1
7	A, SF	A, SF	16.5	6.3
8	A, SF	A, CF	14.0	2.7
9	A, SF	A, CF	16.5	3.5
10	A, SF	A, SF	8.9	3.4

Table B-29

Wire-Insulation Material: PTFE — WSTF ID #: 90-23843
Graphite Depth: 1.2 mm
Time 1: 5 s — Null: 10 s — Time 2: 30 s
Pressure: 10.0 psia (69 kPa) — Gas: 30.1% O_2; 69.9% N_2

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	S	N	0.0	0.0
2	S	N	0.0	0.0
3	S	N	0.0	0.0
4	S	N	0.0	0.0
5	S	N	0.0	0.0
6	S	N	0.0	0.0
7	S	N	0.0	0.0
8	S	N	0.0	0.0
9	S	N	0.0	0.0
10	S	N	0.0	0.0

Table B-30

Wire-Insulation Material: ETFE — WSTF ID #: 90-24097
Graphite Depth: 1.2 mm
Time 1: 5 s — Null: 10 s — Time 2: 30 s
Pressure: 10.0 psia (69 kPa) — Gas: 30.1% O_2; 69.9% N_2

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	A	A, SF	1.3	0.1
2	A	M, SF	0.3	0.1
3	A	M	0.8	0.1
4	A	N, SC	0.8	0.1
5	A	N, SC	0.3	0.0
6	A	N, SC	0.3	0.1
7	A	N, SC	0.8	0.0
8	A	M, SF	0.8	0.1
9	A	N, SC	0.8	0.0
10	S	N, SC	0.0	0.0

Table B-31

Wire-Insulation Material: Kapton
Graphite Depth: 1.2 mm
Time 1: 5 s
Null: 10 s
Pressure: 14.3 psia (99 kPa)
WSTF ID #: 90-23836
Time 2: 30 s
Gas: 26.21% O_2; 73.79% N_2

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	A, SF	A, CF	8.4	1.9
2	M, SF	M, SF	15.2	2.8
3	A, SF	M, SF	7.6	2.4
4	A, SF	A, CF	18.5	4.9
5	A, SF	A, CF	11.4	4.2
6	A, SF	M, SF	2.0	0.1
7	A, SF	A, CF	11.4	4.4
8	A, SF	M, SF	3.8	0.5
9	A, SF	A, CF	15.5	3.2
10	A, SF	A, CF	12.7	3.8

Table B-32

Wire-Insulation Material: PTFE
Graphite Depth: 1.2 mm
Time 1: 5 s
Null: 10 s
Pressure: 14.3 psia (99 kPa)
WSTF ID #: 90-23843
Time 2: 30 s
Gas: 26.21% O_2; 73.79% N_2

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	S	N	0.0	0.0
2	S	N	0.0	0.0
3	S	N	0.0	0.0
4	S	N	0.0	0.0
5	S	N	0.0	0.0
6	S	N	0.0	0.0
7	S	N	0.0	0.0
8	S	N	0.0	0.0
9	S	N	0.0	0.0
10	S	N	0.0	0.0

Table B-33

Wire-Insulation Material: ETFE — WSTF ID #: 90-24097
Graphite Depth: 1.2 mm
Time 1: 5 s — Null: 10 s — Time 2: 30 s
Pressure: 14.3 psia (99 kPa) — Gas: 26.21% O_2; 73.79% N_2

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	A	A, SF	0.8	0.0
2	A	A, SF	0.8	0.0
3	S	N, SC	0.0	0.0
4	A	N, SC	0.8	0.1
5	A	S, SC	0.8	0.0
6	A	A, SF	1.5	0.2
7	A	N, SC	1.3	0.1
8	A	A, SF	1.3	0.1
9	A	N, SC	0.8	0.1
10	A	N, SC	0.3	0.0

Table B-34

Wire-Insulation Material: Kapton — WSTF ID #: 90-23836
Graphite Depth: 1.2 mm
Time 1: 5 s — Null: 10 s — Time 2: 30 s
Pressure: 14.7 psia (101 kPa) — Gas: 20.9% O_2; 79.1% N_2

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	A, SF	A, CF	12.5	4.4
2	A, SF	A, CF	7.4	2.0
3	A, SF	A, CF	18.0	4.0
4	A, CF	A, CF	13.5	4.5
5	A, SF	A, CF	8.4	3.2
6	A, SF	A, CF	8.4	3.3
7	A, SF	A, CF	9.7	1.4
8	A, SF	SF	1.3	0.1
9	A, SF	A, CF	8.4	2.5
10	A, SF	SF	3.3	0.4

Table B-35

Wire-Insulation Material: PTFE — WSTF ID #: 90-23843
Graphite Depth: 1.2 mm
Time 1: 5 s — Null: 10 s — Time 2: 30 s
Pressure: 14.7 psia (101 kPa) — Gas: 20.9% O_2; 79.1% N_2

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	S	N	0.0	0.0
2	S	N	0.0	0.0
3	S	N	0.0	0.0
4	S	N	0.0	0.0
5	S	N	0.0	0.0
6	S	N	0.0	0.0
7	S	N	0.0	0.0
8	S	N	0.0	0.0
9	S	N	0.0	0.0
10	S	N	0.0	0.0

Table B-36

Wire-Insulation Material: ETFE — WSTF ID #: 90-24097
Graphite Depth: 1.2 mm
Time 1: 5 s — Null: 10 s — Time 2: 30 s
Pressure: 14.7 psia (101 kPa) — Gas: 20.9% O_2; 79.1% N_2

Test Number	Time 1 Observations	Time 2 Observations	Total Burn Length (cm)	Sample Weight Loss (g)
1	A	M	0.8	0.0
2	A	N, SC	1.3	0.1
3	A	N, SC	1.0	0.1
4	A	N, SC	1.0	0.0
5	A	N, SC	0.8	0.0
6	A	N, SC	0.8	0.0
7	A	N, SC	0.8	0.0
8	A	N, SC	0.3	0.0
9	A	N, SC	0.8	0.0
10	A	N, SC	0.8	0.1

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FROM: Sonja Wood (ext. 5674)

RE: *WSTF TR-651-001, Validation of NHB 8060.1C, Test 18 Arc Tracking,* September 30, 1991

TON: EMA

DATE: October 4, 2004

NASA REVIEWER:
The attached report has been requested for public release by an external source, thereby permitting the information to be used in compiling an Ignition Handbook. The test report was originally transmitted in 1991. This request comes via David Hirsch; please see attached email.

Please let me know if you see problems. Thank you for your assistance.

Sonja

Subject: FW: Report

Sonja, do we have an electronic version? Is this accessible on line?

-----Original Message-----
From: Vyto Babrauskas, Ph.D. [mailto:vytob@doctorfire.com]
Sent: Friday, July 30, 2004 6:21 PM
To: Hirsch, David B.
Subject: Report

Hi David,

I've just come across this citation:
Steinberg, T. A., "Validation of NHB 8060.1C, Test 18 - Arc Tracking," NASA Test Report, TR-651-001, NASA White Sands Test Facility, Las Cruces, New Mexico, September, 1991.
Could I get a copy?

By the way, is there anyplace on-line that one may retrieve such stuff?

Thanks!

Best regards,
Vytenis (Vyto) Babrauskas, Ph.D.
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